UI Bulletin #160c

Subject:	**Power Take Off (PTO) Subsystem Operating Description and Application Guide**
Models Years Affected:	2020 and Beyond
Models Affected:	Chevrolet Silverado 2500 and 3500 HD Series GMC Sierra 2500 and 3500 HD Series Pick-up and Chassis Cab Models with PTO
Origination Date:	May 1, 2020
Revision Date:	February 21, 2022

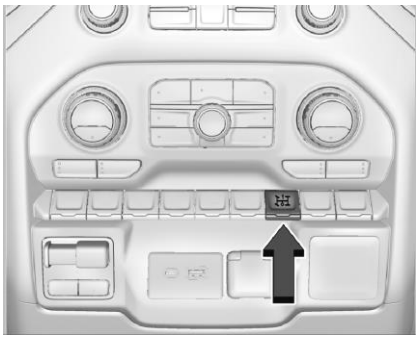
ADVISORY:

PTO System Description:

The Power Take-Off (PTO) is an integrated sub-system that provides an auxiliary power source for running add-on equipment, such as salt spreaders, snow plows, winches, and lift buckets. It controls engine speed to values higher than normal base idle, PTO integral clutch engagement, and remote starting and shutdown of the engine. This document provides details of many of the Operational Description and Application Guides.

PTO switch:

PTO activation is accomplished by the PTO Enable switch located in the center stack of the Instrument Panel (IP) as shown below.



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IMPORTANT:

On a new unit before *anything* is connected, start the truck in park with the park brake set and the Cruise Control Switch is OFF. Press and release the PTO in-cab Switch. You should be able to achieve the 3-speed operation described above. If not, have the dealer fix it before you proceed! When proper idle up operation is confirmed THEN connect your components.

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1. Quick Start Reference - Power Take-Off (PTO)

The PTO system controls engine speed to values higher than normal base idle, PTO engagement, and remote operation of PTO engine speed and start/stop features.

PTO Components

The OEM PTO components consist of:

- The transmission [internal] PTO gear – rotates with the torque converter
- The in-cab PTO switch and cruise control SET and RES switches
- The PTO telltale indicator
- The Driver Information Center (DIC)
- The Radio and Navigation Screen (HMI)
- The Power Take Off Module (PTOM)
- The PTO Unit
- The ON/Off Solenoid
- The Pressure Sensor
- The Remote PTO Upfitter connector [X176]

Note: The interface connector [X176] is located underneath the cab, near the LH (Driver's side) frame rail and comes with a cap which is the mating half to the truck harness connector. This is the connector the Upfitter will use to wire in necessary external electrical components such as external switches to control the PTO from outside the cab.

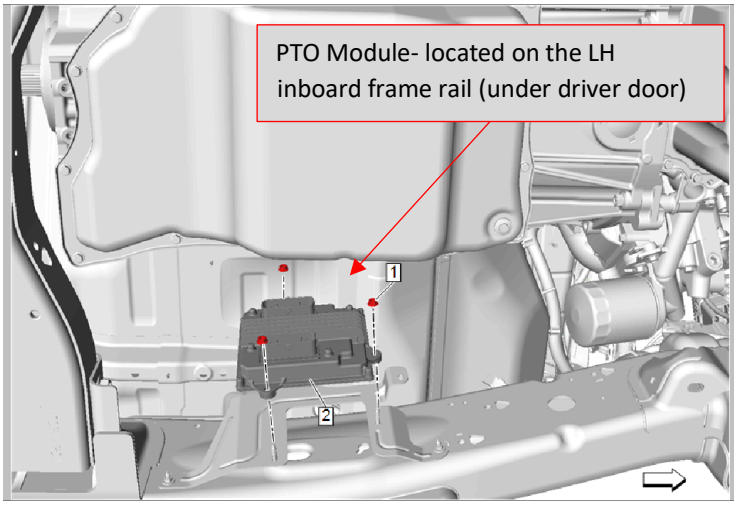

Figure 1

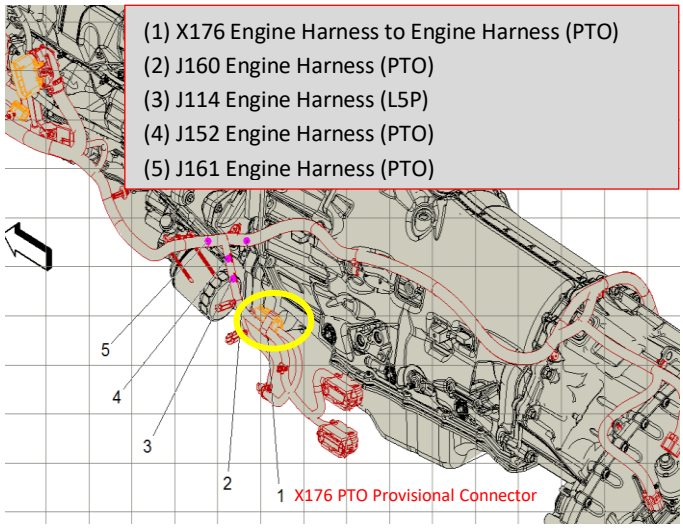

Figure 2

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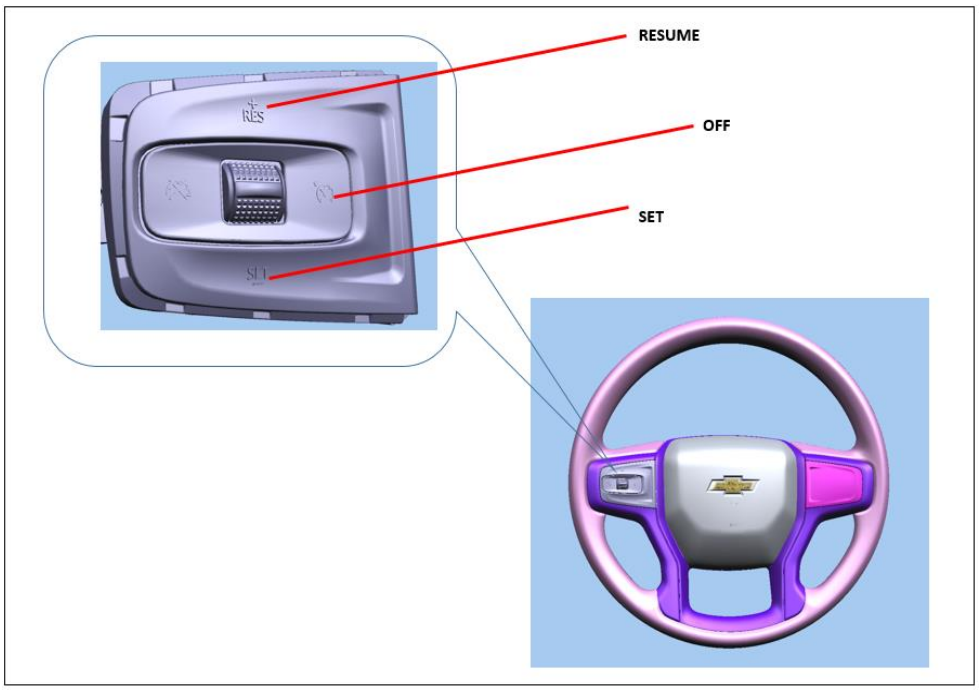


(On/Off): Press to turn the system on or off. The indicator light is white when cruise control is on and turns off when cruise control is off.

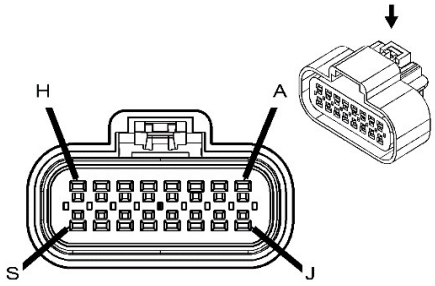
+RES (Resume/Accelerate): If there is a set speed in memory, press briefly to resume to that speed or press and hold to accelerate. If cruise control is already active, use to increase vehicle speed.

SET– (Set/Coast): Press briefly to set the speed and activate cruise control. If cruise control is already active, use to decrease vehicle speed.

(Cancel): Press to disengage cruise control without erasing the set speed from memory.

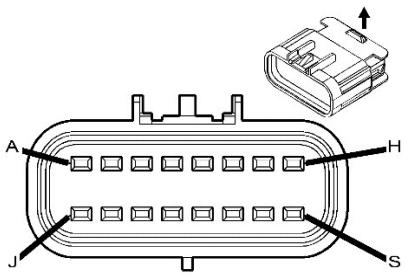
Figure 4

X176 Engine Harness to Power Take-Off Jumper Harness



Connector Part Information [truck side]

Harness Type: Engine
OEM Connector: 15326863
Service Connector: 19180282
Description: 16-Way F 150 GT Series, Sealed (BK)



Connector Part Information [Upfitter Cap]

- Harness Type: Power Take-Off Jumper
- OEM Connector: 15326868
- Service Connector: 15306364
- Description: 16-Way M 150 Series, Sealed (BK)

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Terminal Type ID	Terminated Lead	Service Terminal
I	13575412	12191819
II	13575412	12191819
III	19368215	12191819
IV	13576364	15326269

Pin	Size	Color	Circuit	Terminal Type ID	Function	Pin	Size	Color	Circuit	Terminal Type ID
A	0.75	GY/GN	6239	I	Transmission Power Take Off Engage/Disengage Signal Power	A	—	—	—	—
B - C	—	—	—	—	Not Occupied	B - C	—	—	—	—
D	1.5	BK	4450	III	Ground	D	—	—	—	—
E - F	—	—	—	—	Not Occupied	E - F	—	—	—	—
G	0.5	WH/BK	8238	II	—	G	—	—	—	—
H	—	—	—	—	Not Occupied	H	—	—	—	—
J	0.5	WH/GN	6142	II	Power Take Off Engine Shutdown Signal	J	—	—	—	—
K	0.75	RD/VT	2640	I	Battery Positive Voltage	K	—	—	—	—
L - M	—	—	—	—	Not Occupied	L - M	—	—	—	—
N	0.5	VT/GN	4308	II	Power Take Off Remote Throttle Signal	N	—	—	—	—
P	—	—	—	—	Not Occupied	P	—	—	—	—

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2. Factory PTO Settings

The PTO system is *programmed in the plant for a basic 3 speed idle up [Stationary Preset] mode* with the clutch control circuit enabled. The System is ready to operate, unless further electrical interfaces are required by the Upfitter's equipment (reference schematics shown below).

The 3 factory speeds are:

1. 900 RPM – occurs with press and release of the PTO switch
2. 1200 RPM – occurs with press and release of the Cruise SET switch [if PTO is ON]
3. 1900 RPM – occurs with press and release of the Cruise Resume Switch [if PTO is ON]

See schematic below. The components in the grey shaded box are what must be connected to X176 for basic in cab operation [Stationary Preset].

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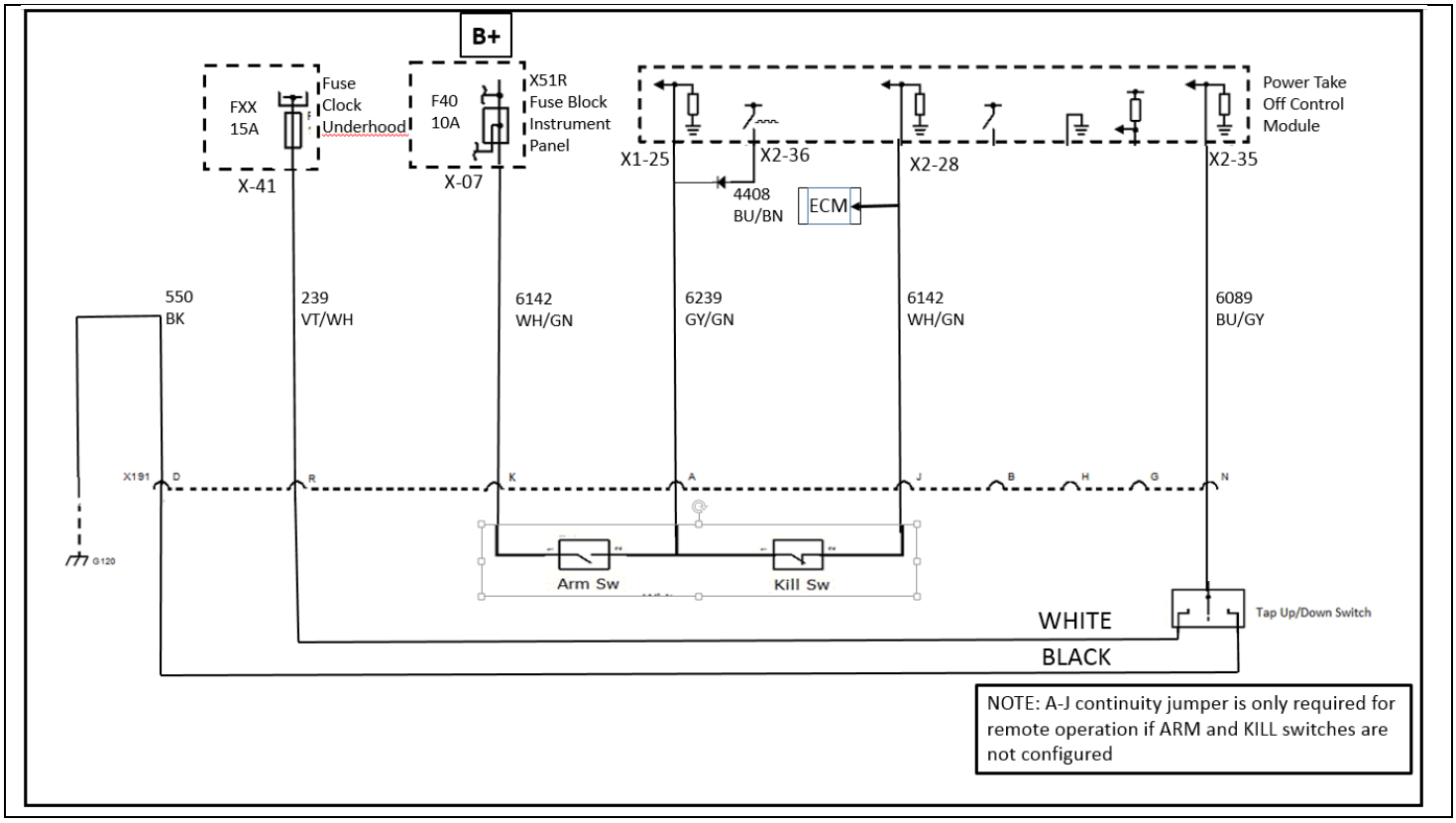
Schematic for:

1. **Basic 'inside' PTO operation**
2. **Optional outside 'remote' operation [start/stop, tap up/down]**



NOTE:

The PTO connector X176 has a cap installed at the assembly plant with a jumper between pins A and J. The cap is a useable mating connector and it could be rewired as shown above. The jumper is only required for remote operation if arm and kill switches are not configured.

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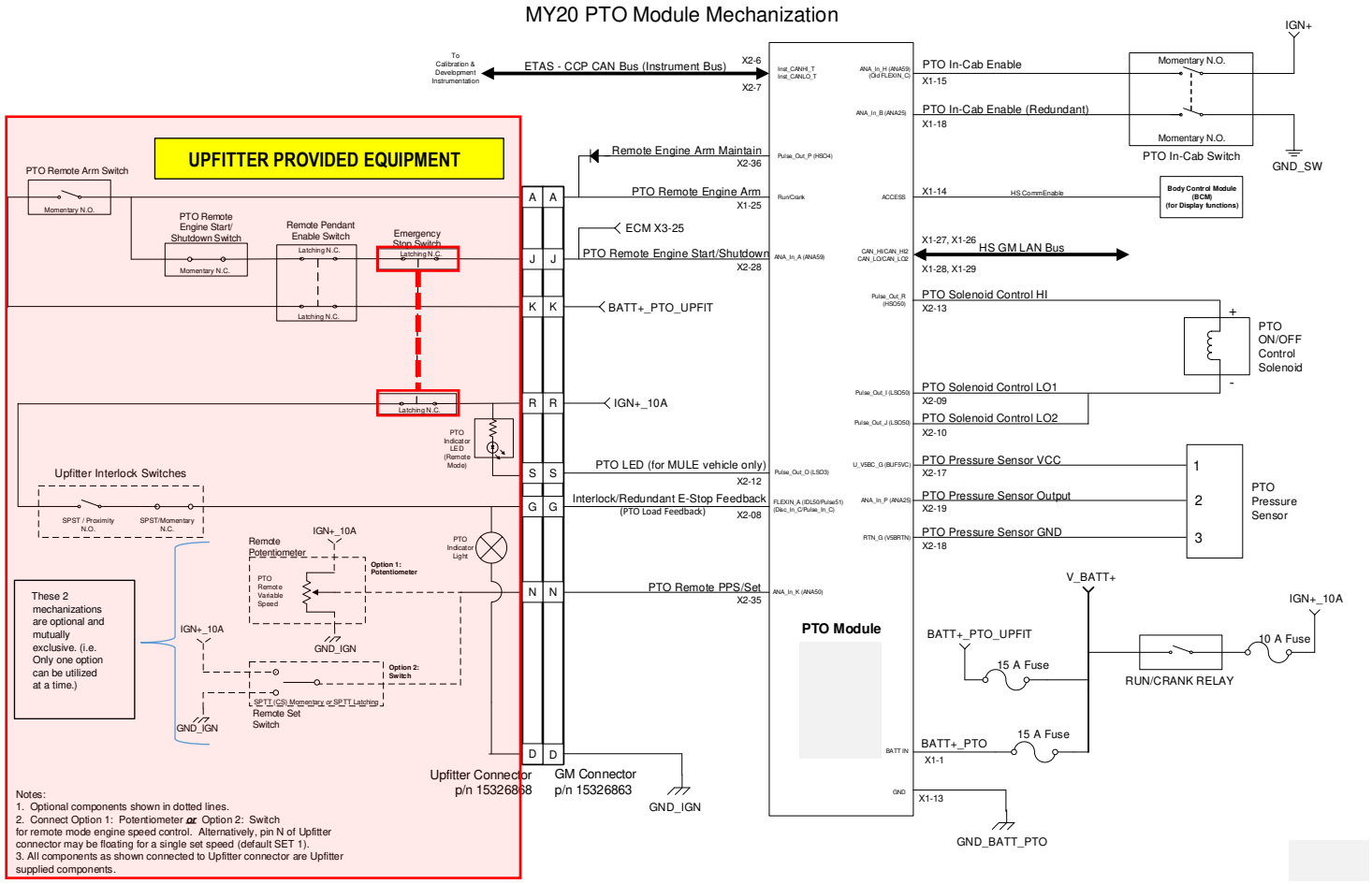
Full System Schematic [including all possible external connections]



NOTES:

1. A to J jumper is not required except for remote modes where the ‘arm’ and ‘kill’ switches are not configured.
2. Engine speed can be controlled from the Remote Pendant using Cavity N Control Signal with a switch **OR** a potentiometer, but not both.

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3. Primary PTO Operating Modes

PTO modes of operation include the following:

- **Preset** [*Stationary*]
  In-cab control standard. Remote control available.

- **Variable** [*Stationary*]
  In-cab control standard. Remote control available.
- **Mobile**
  In-cab control only
- **OSIM** (Operator Selectable In-Cab Mode) [*Stationary or Mobile*],
  Requires 'pairing' and then one of the two 'paired' modes can be selected during a given key cycle.

Notes:

- Factory default programming enables in-cab controls.
- A GM Service Tool can reprogram the system to allow for remote control. In-cab controls can be left active [in-cab engage with remote control] or disabled. OSIM can be enabled for dual stationary/mobile mode pairing.
- All PTO modes provide for engine RPM control and PTO clutch control [engage/disengage].
- All PTO modes provide for safety interlocks for PTO clutch disengagement.
- Remote PTO modes provide for both in-cab and remote engine starting, and shutdown.
- All Stationary PTO modes provide for engine shutdown due to critical engine conditions, as well as a timed engine shutdown feature.
- For remote pendant applications the 'Remote Pendant Enable Switch' must be in the open position when connecting or disconnecting the pendant cable.

4. Preset

Preset PTO - *In-cab Operation:* Enable Conditions [factory default programming]

To Enable PTO the following conditions must be satisfied:

1. Engine must be running.
2. The vehicle cannot be moving.
3. The parking brake must be set.
4. The shift lever must be in PARK [P].
5. The brake pedal must not be depressed.
6. Cruise Control must be OFF.

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7. Press and release the PTO In-cab switch, located below the center console. The PTO telltale will blink rapidly until the PTO clutch becomes engaged (Ref. Note 3 below). The telltale will then be steady. The engine will advance to the PTO Standby speed.
8. After PTO Standby speed is achieved the Cruise Control SET- and RES+ switches can be used to accomplish the Set 1 or Set 2 PTO engine speeds. *Note: The accelerator pedal is disabled and cannot be used to override the PTO present speeds below.*

Factory default PTO engine speeds	
Standby	**900 RPM**
Set 1 (SET-)	**1200 RPM**
Set 2 (RES+)	**1900 RPM**

Note:

On a new vehicle the PTO function [3 speed idle up] should be confirmed before any wiring modifications are done. See your GM dealer if the default presets are not functioning properly.

1. The PTO Control setting is default programmed to Interior PTO Mode. Remote switch inputs are disabled.
2. When the PTO Telltale is either blinking or on solid, the PTO clutch will be activated.

Preset PTO - *Remote Operation:* Enable Conditions [requires programming with GM service tool and installation of an appropriate remote switch panel].

The panel must be provided by the Upfitter. Please refer to the schematics above which show how Upfitter supplied equipment is to be wired.

1. Cruise Control must be OFF (confirm this is OFF before powering down the vehicle with the Ignition key).
2. The shift lever must be in PARK [P].
3. The park brake must be set, and the hood must be closed.
4. The engine must be stopped. Remove the key or keyless start fob (if equipped) from Vehicle (refer to the Warning below).
5. From the Remote Switch Panel close and open the PTO Remote Arm Switch.
6. Within 5 seconds open and close the PTO Remote Engine Start/Shutdown switch

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7. The vehicle horn will chirp 3 times, and then engine starting will automatically be initiated. The PTO system will then elevate engine RPM to PTO standby speed and engage the PTO clutch.
8. The PTO Remote Set switch can now be used to accomplish the PTO Set 1 and Set 2 Engine speeds. *Note: The accelerator pedal is disabled when remote PTO operation is selected.*

Notes:

1. The PTO clutch engages immediately when the PTO operation is initiated by the switch input. This produces a soft engagement because the transmission torque converter is unlocked. The torque converter will lock upon reaching stable PTO Standby Speed [default = 900 RPM] so maximum power is available.
2. The first elevated engine speed – PTO Standby Speed is not intended as a working speed but as a verification that the system is active and ready to go to a working speed. PTO Standby Speed can be modified to a 'working speed' with a GM Service Tool. The upper limit for PTO Standby Speed is 1500 RPM.
3. The remote switches ~~and relay~~ connections are made at the PTO Upfitter Connector located on the chassis frame behind the cab.
4. The PTO Control setting on the Service Tool must be programed to "Remote PTO Mode Switch" before the remote switches can be used.
5. The PTO clutch is programed to be enabled in the factory default settings.

Warning:

Engine exhaust contains Carbon Monoxide (CO) which cannot be seen or smelled. Exposure to CO can cause unconsciousness or even death. Never operate PTO in an enclosed area such as a garage or building that has no fresh air ventilation. See "Engine Exhaust" in the Vehicle Owner Manual.

Warning:

If the key is in the ignition during Remote PTO operation, the vehicle can be shifted out of Park by an operator. Even though PTO will be disengaged, depending on PTO Upfitter application, personal injury or property damage may result from vehicle movement.

Preset PTO - *Remote Operation with In-Cab Engage:* Enable Conditions [requires programming with GM service tool and installation of an appropriate remote switch panel].

Starting Remote Operation from cab.

1. With the engine running shift the transmission into P (Park).
2. Release the brake pedal and set the parking brake.
3. Assure the cruise control is OFF and the hood is closed.

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4. Press and release the In-Cab PTO Switch.
5. The horn will chirp, the PTO clutch will engage, and the engine speed will advance to PTO Standby Speed.
6. The operator may now exit the vehicle. Doors can be locked with key fob [if desired/available].
7. The PTO Remote Set switch can now be used to accomplish the PTO Set 1 and Set 2 Engine speeds. The accelerator pedal is disabled when Remote PTO operation is selected.

PTO Remote operation can be ended by pressing In-Cab PTO Switch, releasing the parking brake, depressing the brake pedal or shifting the transmission out of P (Park). The PTO clutch will disengage, and Engine speed will decline to idle speed.

Warning:

While operating your vehicle in stationary PTO mode, the Diesel Particulate Filter (DPF) will continue to filter the exhaust and accumulate soot. The engine control system, depending on the speed and load being applied by the PTO, may not be able to generate enough energy or adequate heat needed to clean or regenerate the DPF. Continued operation under conditions that do not allow effective regeneration or cleaning will eventually plug the DPF and result in reduced power. The ENGINE POWER IS REDUCED Driver Information Center (DIC) message and Malfunction Indicator Lamp will be displayed, and dealer/retailer service will be required to return your vehicle to normal, full power operation. To prevent this from occurring, frequently monitor your vehicle during PTO operation, paying particular attention to the CLEAN EXHAUST FILTER SEE OWNER MANUAL NOW DIC warning message or any horn chips if operating PTO remotely. If the DIC message [or horn chirp] is presented during PTO operation, see OWNER MANUAL Diesel Particulate Filter for information on how to clean or regenerate the DPF.

Diesel Particulate Filter [DPF] Cleaning during Stationary PTO Operation

If the DPF becomes sufficiently loaded with soot during a PTO session the system will issue a DIC warning message and ***horn chirps*** as notification to the operator. If the operator is outside the vehicle [remote operation] he must return to the cab and, if running in 'key out' mode, insert and rotate the key to the 'run' position (or if equipped with keyless start, with the fob in vehicle, press and hold the engine Start/Stop button) to respond to the system messages. [Messages are not displayed unless the key is in the 'run' position.]

Notes:

- Manual DPF [cleaning] regeneration can be initiated during a PTO idle up session.

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- It is strongly recommended that the exhaust filter be cleaned before continuous PTO usage if possible.
- If a manual regen is initiated during the PTO session the PTOM will retain control of the engine speed and the selected speed will not change as the regen event initiates.
- Low PTO engine speeds and light loading will cause regeneration to take longer. To initiate a manual DPF regeneration, see “Manual Regeneration of Diesel Particulate Filter” under Diesel Particulate Filter in the Duramax Diesel Supplement pamphlet in the glove box. Refer to the latest revision of UI Bulletin142 “Diesel Particulate Filter [DPF] Manual Regeneration” for more detail. (https://www.gmupfitter.com/pages/technical-bulletins)

Warning:

The exhaust system and exhaust gases get very hot during a manual regeneration. Things that burn could touch hot exhaust parts under the vehicle and may catch fire. You or others could be burned. Do not leave the vehicle unattended during a manual regeneration. If operating from outside the vehicle maintain a safe personal distance away from the hot exhaust or you could be burned.

5. Variable PTO

Variable PTO - *In-cab operation*: Enable Conditions - [requires programming with GM Service tool]

1. With the engine running shift the transmission to P [PARK].
2. Release the brake pedal and set the parking brake.
3. Assure the cruise control is OFF and the hood is closed.
4. Press and release the PTO In-cab switch. The PTO telltale will blink rapidly until the PTO clutch becomes engaged. The telltale will then be steady. The engine will advance to the PTO Standby speed.
5. After PTO Standby speed is achieved, the Cruise Control Set - and Res + switches can be used to tap up and tap down the engine speed.

Notes:

1. Factory setting for the tap step is 100 RPM and the setting for the ramp rate is 148 RPM/sec. The GM Service Tool can enable the capability to change the default value for tap step via the Radio Customization menu. The default values for both tap step and for ramp rate can be changed with a GM Service Tool.
2. The accelerator pedal is disabled and cannot be used to control PTO engine speed.
3. [Stationary] Variable PTO operation can be ended by pressing In-Cab PTO Switch, releasing the parking brake, depressing the brake pedal or shifting the transmission out of P (Park). The PTO clutch will disengage, and Engine speed will decline to idle speed.

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Variable PTO - *Remote Operation*: Enable Conditions - [requires programming with GM Service tool and appropriate remote switch panel provided by Upfitter]

1. Hood must be closed. Shift the transmission to P [Park] and set the parking brake.
2. Assure the Cruise Control is OFF, Turn the engine off, remove the key or keyless start fob (if equipped) from Vehicle (*).
3. The operator may now exit and lock vehicle.
4. From the Remote Switch Panel close and open the PTO Remote Arm Switch.
5. Within 5 seconds open and close the PTO Remote Engine Start/Shutdown switch
6. The vehicle horn will chirp 3 times, and then engine starting will automatically be initiated. The PTO system will then elevate engine RPM to PTO Standby speed and engage the PTO clutch.
7. The desired engine operating speed can now be accomplished. Two versions of engine RPM control are available, switches or potentiometer [according to which one was installed].
    A. Switches – the PTO Remote Tap Up and Tap Down switches can be used to achieve the desired engine speed.
    B. Potentiometer – a PTO Remote Throttle Potentiometer can be used as a continuous variable throttle control to dial in the desired engine speed.

Notes:

1. PTO Remote operation can be ended by:
    A. Opening the remote kill switch
    B. Pressing In-Cab PTO Switch
    C. Releasing the parking brake
    D. Depressing the brake pedal
    E. Shifting the transmission out of P (Park). The PTO clutch will disengage, and Engine speed will decline to idle speed.

2. The PTO clutch engages immediately when the PTO operation is initiated by the switch input. The first elevated engine speed – PTO Standby Speed is not intended as a working speed but as a verification that the system is active and ready to go to a working speed.
3. The remote switches and throttle control [if used] are made at the PTO Upfitter Connector [X176] located as shown in figure 2.
4. The engine speeds can be adjusted between the low of PTO Standby Speed and the high of PTO Max Engine speed limits. Both values can be modified from the factory default settings with a GM Service Tool.
5. Factory setting for the tap step is 100 RPM and the setting for ramp rate is 148 ~~150~~ RPM/sec. The default value for tap step can be modified via the Radio Customization menu. The default values for both tap step and for ramp rate can be changed with a GM Service Tool.

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6. The PTO Control setting must be programmed to “PTO Remote Mode Switch Status = Enabled” with Service Tool.
7. The potentiometer option for controlling PTO engine speed is selected with the Service Tool by setting “PTO Remote Mode Switch Configuration = Variable.”

Warning:

Engine exhaust contains Carbon Monoxide (CO) which cannot be seen or smelled. Exposure to CO can cause unconsciousness or even death. Never operate PTO in an enclosed area such as a garage or building that has no fresh air ventilation. See “Engine Exhaust” in the Vehicle Owner Manual.

(*) Warning:

If the key is in the ignition during Remote PTO operation, the vehicle can be shifted out of Park by an operator. Even though PTO will be disengaged, depending on PTO Upfitter application, personal injury or property damage may result from vehicle movement. Always remove key from the ignition before operating Remote PTO.

Variable PTO - *Remote Operation with In-Cab Engage*: Enable conditions [requires programming with GM Service tool and appropriate remote switch panel provided by Upfitter]

Starting Remote Operation from cab.

1. With the engine running shift the transmission to P (Park) and release the brake pedal.
2. Assure the cruise control is OFF and the hood is closed.
3. Set the parking brake
4. Press and release the In-Cab PTO Switch.
5. The horn will chirp, the PTO clutch will engage, and the engine speed will advance to PTO Standby Speed.
6. The operator may now exit the vehicle. The vehicle doors may be locked with the key fob [if desired/available]
7. From the exterior panel the desired engine operating speed can now be accomplished. Two versions of engine RPM control are available, switches or potentiometer, depending on which was installed.
    A. Switches - the PTO Remote Set Switch can be used to tap up and tap down to the desired engine speed.
    B. Potentiometer - a PTO Remote Throttle Potentiometer can be used as a continuous variable throttle control to dial in the desired engine speed.

Notes:

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1. The accelerator pedal is disabled when Remote PTO operation is selected.
2. PTO Remote operation can be ended by:
    A. Opening the remote kill switch [if wired and configured]
    B. Pressing In-Cab PTO Switch
    C. Releasing the parking brake
    D. Depressing the brake pedal
    E. Shifting the transmission out of P (Park). The PTO clutch will disengage, and Engine speed will decline to idle speed.

Warning:

While operating your vehicle in stationary PTO mode, the Diesel Particulate Filter (DPF) will continue to filter the exhaust and accumulate soot. The engine control system, depending on the speed and load being applied by the PTO, may not be able to generate enough energy or adequate heat needed to clean or regenerate the DPF. Continued operation under conditions that do not allow effective regeneration or cleaning will eventually plug the DPF and result in reduced power. The ENGINE POWER IS REDUCED Driver Information Center (DIC) message and Malfunction Indicator Lamp will be displayed, and dealer/retailer service will be required to return your vehicle to normal, full power operation. To prevent this from occurring, frequently monitor your vehicle during PTO operation, paying particular attention to the CLEAN EXHAUST FILTER SEE OWNER MANUAL NOW DIC warning message or any horn chips if operating PTO remotely. If the DIC message [or horn chirp] is presented during PTO operation, see OWNER MANUAL Diesel Particulate Filter for information on how to clean or regenerate the DPF.

Diesel Particulate Filter [DPF] Cleaning during Stationary PTO Operation

If the DPF becomes sufficiently loaded with soot during a PTO session the system will issue a DIC warning message and ***horn chirps*** as notification to the operator. If the operator is outside the vehicle [remote operation] he must return to the cab and, if running in 'key out' mode, insert and rotate the key to the 'run' position to respond to the system messages. [Messages are not displayed unless the key is in the 'run' position.]

Notes:

- Manual DPF [cleaning] regeneration can be initiated during a PTO idle up session.
- It is strongly recommended that the exhaust filter be cleaned before continuous PTO usage if possible.
- If a manual regen is initiated during the PTO session the PTOM will retain control of the engine speed and the selected speed will not change as the regen event initiates.
- Low PTO engine speeds and light loading will cause regeneration to take longer.

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To initiate a manual DPF regeneration, see “Manual Regeneration of Diesel Particulate Filter” under Diesel Particulate Filter in the Duramax Diesel Supplement pamphlet in the glove box. See UI Bulletin xxx DPF Regen for more detail.

Warning:

The exhaust system and exhaust gases get very hot during a manual regeneration. Things that burn could touch hot exhaust parts under the vehicle and may catch fire. You or others could be burned. Do not leave the vehicle unattended during a manual regeneration. If operating from outside the vehicle maintain a safe personal distance away from the hot exhaust or you could be burned.

6. Mobile PTO

Mobile PTO - *in-cab operation only*: Enable Conditions - [requires programming with GM Service tool]

1. Engine must be running.
2. Cruise Control must be OFF.
3. Engine RPM must be less than 1500 RPM [Maximum PTO Engage Speed]
4. Transmission Shift Lever must be in manual shift selection L1, L2, L3, L4, or L5 the brake must be tapped at least once and then remain released.
5. Keep the driver door closed. [The driver door can be kept open if reconfigured using GM service tool.]
6. Press and release the PTO In-cab switch. The PTO telltale will blink rapidly until the PTO clutch becomes engaged. The telltale will then be steady. The engine speed will remain at the current throttle setting or advance to PTO Standby Speed, which ever value is greater. If the engine RPM is above 1500 RPM, the PTO clutch will not engage until the engine RPM drops below 1500.
7. Once engaged if additional engine speed is desired two control methods are available – Cruise switches or accelerator pedal.

    A. Cruise Res + switch can be used to tap up [or if continuously held to ramp up (see Table in Section 11 for factory preset parameters)] to the desired operating speed. The Cruise Set - switch can be used to tap down [or coast down if continuously held] to the desired engine speed. [Top limit is PTO Max Engine Speed – default 2100 RPM and programmable to 2500 RPM. Lower limit is PTO Standby Speed – default 900 RPM with program range from base idle to 1500 RPM.]

    B. Accelerator pedal – can be used to achieve the desired speed. When the desired speed is accomplished the Cruise Set - switch would be used to capture and maintain that speed.

    Normal tap up and tap down can then be used to fine tune the setting.

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Notes:

1. In Mobile PTO mode the vehicle speed achieved is the result of the current engine speed requested and the transmission gear range selected. The gears available for selection are L1 through L5. The transmission may limit the selection of a higher gear is reached. Attempts to up-shift higher than L5 will not allowed by the transmission system.
2. Mobile mode [engine speed capture] is disengaged similarly to cruise control disengagement. See PTO System Disengage Conditions - Mobile Mode for more details.

7. OSIM PTO (Operator Selectable In-Cab Mode)

Requires programming with GM service tool to configure Stationary & Mobile '*Paring*.' Available '*pairs*' are *preset and mobile* or else *variable and mobile*. Used for vehicles that require 2 PTO modes. Remote operation is not available.

OSIM PTO - *Preset [Stationary] Operation*: Enable Conditions

OSIM Preset operation can be initiated as follows:

1. With the engine running shift the transmission into P (Park) and release the brake pedal.
2. Assure the cruise control is OFF and the hood is closed.
3. Set the parking brake.
4. Press and release the In-Cab PTO Switch - the PTO indicator LED will begin flashing.
5. Within 10 seconds press and release the cruise Set (-) switch. The PTO indicator LED will go ON steady, the PTO clutch will engage, and the engine RPM will advance to PTO Standby Speed.
6. Again, press and release the Cruise Set (-) switch to go to PTO Set 1 Speed.
7. Press and release the Cruise Resume (+) switch to go to PTO Set 2 Speed.

OSIM PTO - *Variable [Stationary] Operation*: Enable Conditions

OSIM Variable Stationary Operation can be initiated as follows:

1. With the engine running shift the transmission into P (Park) and release the brake pedal.
2. Assure the cruise control is OFF and the hood is closed.
3. Set the parking brake.
4. Press and release the In-Cab PTO Switch - the PTO indicator LED will begin flashing. Within 10 seconds press and release the cruise Set (-) switch. The PTO indicator LED will go ON steady, the PTO clutch will engage, and the engine RPM will advance to PTO Standby Speed.
5. The desired operating speed can now be accomplished by tapping up and down with the Cruise Resume (+) and Set (-) switches.

OSIM PTO - *Mobile Operation*: Enable Conditions

OSIM Mobile Operation can be initiated as follows:

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1. Engine must be running.
2. Cruise Control must be OFF.
3. Engine RPM must be less than 1500 RPM [Maximum PTO Engage Speed]
4. With the vehicle rolling slowly, shift the transmission to L1, L2, L3, L4, or L5
5. The brake pedal must be tapped at least once and then remain released.
6. Press and release the PTO In-cab switch. The PTO telltale will blink rapidly.
7. Within 10 seconds press and release the cruise control resume (+) switch. The PTO indicator light will continue blinking rapidly until the clutch becomes engaged and then come ON steady. The engine RPM will advance to PTO Standby Speed if that is greater than the engagement speed. If the engine speed is above 1500 RPM when engagement is attempted the PTO clutch will not engage until the engine RPM moves below 1500.
8. Once engaged the engine speed will hold steady at the PTO Standby Speed setting. The desired engine speed can now be adjusted with the cruise control buttons or the accelerator pedal. The cruise set (-) and resume (+) buttons will operate similar to normal highway cruise operation to either tap up and down or ramp up and down. The desired engine RPM can also be captured with the cruise set switch and then fine-tuned by tap up and tap down operations.
9. After initial engagement, if the service brake must be applied, the engine RPMs will drop, and the PTO will not attempt to hold engine speed until it is again initiated [latched up] with the cruise Resume (+) switch. Once the resume (+) switch is pressed, the engine speed will slowly move to the last 'captured' speed.

Notes:

1. In Mobile PTO mode the vehicle speed achieved is the result of the current engine speed requested and the transmission gear range selected. The gears available for selection are L1 through L5. The transmission may limit the selection of a higher gear is reached. Attempts to up-shift higher than L5 will be denied by the transmission system.
2. Mobile mode [engine speed capture] is disengaged similarly to cruise control disengagement. See PTO System Disengage Conditions - Mobile Mode for more details.

8. PTO System Disengage Conditions

Stationary Modes [preset or variable] - in-cab control

To disengage PTO, perform one of the following actions:

- Depress the brake pedal. The engine returns to base idle, but the PTO clutch remains engaged. The PTO Telltale will blink slowly indicating that a PTO Set Speed is still stored in memory. Upon releasing the brake, the factory default programming is for the engine speed to remain at curb idle. Pressing and releasing the Cruise Res

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+ Switch will restore engine RPM to the last PTO Set speed. The PTO system can also be programmed to return engine RPM to the PTO Standby Speed setting.

- Depress the Cruise Cancel switch. The engine returns to base idle, but the PTO clutch remains engaged. The PTO Telltale will blink slowly indicating that a PTO Set Speed is still stored in memory. Activating the Cruise Res + switch, will restore engine RPM to the last PTO Set speed.
- Press and release the PTO in-cab switch. The PTO clutch disengages, and engine returns to base idle. The PTO Telltale will turn OFF indicating the PTO clutch is disengaged and the stored set speed has been cleared from memory.
- Release Park Brake.
- Move shift lever from PARK [P] position.

Stationary Modes [preset or variable] - remote control [with or without in-cab engage]

To disengage PTO, perform any of the following actions:

- Open the PTO Remote Engine Start/Shutdown switch. PTO clutch disengages, and engine will stop.
- Assert the PTO Emergency Stop Switch. PTO clutch disengages, and engine will stop.
- Press and release the In-cab PTO switch.
- With the Remote Operation In-Cab Enable feature remote PTO operation may be ended by pressing the brake pedal, at which time the PTO clutch disengages and the engine returns to base idle speed. The vehicle can be driven after the parking brake is released. Note: If the PTO Remote session has been initiated from the remote pendant then for keyed equipped vehicles, insert the key in the ignition and rotate to the RUN position, and press the brake pedal. For keyless equipped vehicles, hold push button start for 2 seconds, and press the brake pedal.

Stationary Modes will also disengage if:

- Vehicle movement is detected.
- Park Brake is released.
- Transmission is shifted out of PARK [P].
- Vehicle mode of operation goes from “Run/Crank” to “Off” position. Refer to the vehicle owner manual for information on the mode of operation
- PTO Interlock/Redundant E-Stop feedback signal is lost if used. See full system schematic (refer to figure on page 9).
- Cruise becomes ENABLED (Cruise ON/OFF switch pressed)
- Timed auto-engine shutdown: The timed auto-engine shutdown feature provides the means to shut down the engine automatically after a predefined time. PTO must be operational for this function to be active.

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- Engine shutdown based on critical engine or PTO system fault conditions: The engine will be shut down when PTO is operating if a critical engine condition is detected by the vehicle system (i.e., low oil, low oil pressure, hot engine, hot transmission, low fuel, Diesel Particulate Filter (DPF) regeneration). If PTO operation is continued when critical engine conditions are present, a horn chirp warning will occur. The engine will shutdown 2 minutes after the horn warning. The operator can restart the engine with the ignition key or with the PTO remote engine start controls or push button start. The above horn warning and engine shutdown will again occur if the critical engine condition is still present.

- **Emergency Vehicle provisions for PTO are limited to the disabling the following Automatic Engine Shutdown conditions***

  a. **Low Fuel**
  b. **Engine Coolant Hot**
  c. **Transmission Fluid Hot (verify product offering w/program team)**
  d. **Low Engine Oil**
  e. **Low Engine Oil Pressure**
  f. **Diesel Particulate Filter Regeneration Warning**

***These provisions are available thru GM special emergency package RPO YF2. Reference section 13 of this Bulletin.**

Notes:

When PTO remote engine starting has been initialed with the ignition key in the “Run” position, the Shift Lever will remain locked if the brake pedal is pressed and shift from Park is attempted while the engine is running, and PTO is active (stand-by mode). At this point, a shift to Park will not be allowed until one of the following actions is taken by the vehicle operator:

- Press the PTO Remote Engine Start/Shutdown
- Press and release the in-cab PTO switch
- Press Cruise Cancel or toggle the Cruise Control switch to ON
- Release Park Brake

Mobile Mode

To Disengage PTO:

- Depress the brake pedal. The PTO system releases control of engine speed, but the PTO clutch remains engaged (if configured). Engine will return to base idle unless the accelerator pedal is depressed. The PTO clutch-remains engaged. The PTO Telltale will blink slowly indicating that a PTO Set Speed is still stored in memory.

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Upon releasing the brake, the factory default programming is for the engine speed to remain at base idle awaiting a press and release of the Cruise Res + Switch which will restore engine RPM to the last PTO Set speed. The system can also be programmed to return engine RPM to the PTO Standby Speed setting. Speed is still stored in memory. Upon releasing the brake, the factory default programming is for the engine speed to remain at curb idle awaiting an input from the Cruise Res + Switch to restore engine RPM to the last PTO Set speed. The system can also be programmed to return engine RPM to the PTO Standby Speed setting.

- Press and release the Cruise Cancel switch. The engine returns to base idle; but the PTO clutch remains engaged. The PTO Telltale will blink slowly indicating that a PTO Set Speed is still stored in memory. Pressing and releasing the Cruise Res + switch, will restore engine RPM to the last PTO Set speed.
- Press and release the PTO in-cab switch. PTO will be disengaged with the initial 'press' of the switch and engine speed will return to base idle. The PTO Telltale will go OFF indicating the PTO clutch is disengaged and the stored set speed has been cleared from memory.

Mobile Mode will also disengage if any of these actions or events take place:

- PTO feedback input is lost [load disengaged] if configured.
- Vehicle Speed exceeds Max Vehicle Speed. Factory default setting = 58 MPH
- Engine Speed exceeds Max Engine Speed for greater than 15 seconds. Factory default setting = 2100 RPM.
- The Cruise Control On/Off switch is toggled to ON.
- The Park Brake is applied.
- Maximum PTO engine torque limit (340 Nm for 5 consecutive seconds)

Notes:

1. Resume memory speed is cleared for the above actions.
2. Although the PTO system attempts to limit accelerator and PTO switch inputs to comply with maximum speed and /or RPM parameters, some vehicle operating conditions such as downhill acceleration can cause the vehicle speed or engine RPM to exceed these limits and in those cases the PTO system may disengage.

9. Prolonged or Extended PTO Operation

Warning:

While operating your vehicle in stationary PTO mode, the Diesel Particulate Filter (DPF) will continue to filter the exhaust and accumulate soot. The engine control system, depending on the speed and load being applied by the PTO, may not be able to generate enough energy or adequate heat needed to clean or regenerate the DPF. Continued operation under conditions that do not allow effective regeneration or cleaning will eventually plug the DPF and result in

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reduced power. The ENGINE POWER IS REDUCED Driver Information Center (DIC) message and Malfunction Indicator Lamp will be displayed, and dealer/retailer service will be required to return your vehicle to normal, full power operation. To prevent this from occurring, frequently monitor your vehicle during PTO operation, paying particular attention to the CLEAN EXHAUST FILTER SEE OWNER MANUAL NOW DIC warning message or any horn chips if operating PTO remotely. If the DIC message [or horn chirp] is presented during PTO operation, see OWNER MANUAL Diesel Particulate Filter for information on how to clean or regenerate the DPF.

Diesel Particulate Filter [DPF] Cleaning during Stationary PTO Operation

If the DPF becomes sufficiently loaded with soot during a PTO session the system will issue a DIC warning message and ***horn chirps*** as notification to the operator. If the operator is outside the vehicle [remote operation] he must return to the cab and, if running in 'key out' mode, insert and rotate the key to the 'run' position to respond to the system messages. [Messages are not displayed unless the key is in the 'run' position.]

Notes:

- Manual DPF [cleaning] regeneration can be initiated during a PTO idle up session.
- It is strongly recommended that the exhaust filter be cleaned before continuous PTO usage if possible.
- If a manual regen is initiated during the PTO session the PTOM will retain control of the engine speed and the selected speed will not change as the regen event initiates.
- Low PTO engine speeds and light loading will cause regeneration to take longer.

To initiate a manual DPF regeneration, see "Manual Regeneration of Diesel Particulate Filter" under Diesel Particulate Filter in the Duramax Diesel Supplement pamphlet in the glove box. See UI Bulletin xxx DPF Regen for more detail.

Warning:

The exhaust system and exhaust gases get very hot during a manual regeneration. Things that burn could touch hot exhaust parts under the vehicle and may catch fire. You or others could be burned. Do not leave the vehicle unattended during a manual regeneration. If operating from outside the vehicle maintain a safe personal distance away from the hot exhaust or you could be burned.

Warning:

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Engine exhaust contains Carbon Monoxide (CO) which cannot be seen or smelled. Exposure to CO can cause unconsciousness or even death. Never operate PTO in an enclosed area such as a garage or building that has no fresh air ventilation. See “Engine Exhaust” in the Vehicle Owner Manual.

Warning:

If the key is in the ignition during Remote PTO operation, the vehicle can be shifted out of Park by an operator. Even though PTO will be disengaged, depending on PTO Upfitter application, personal injury or property damage may result from vehicle movement.

10. PTO Operational Speed Control

[Variable] PTO operational speed control provides the following functions:
Cruise Set - Switch (In-cab) or Remote PTO Tap Down switch

- **SET:** [in cab operation] - press and hold the accelerator to obtain the desired engine speed, then press and release the Set - position on the Cruise Switch. The current engine speed will be maintained. This action can be repeated as desired to a higher RPM value. The PTO set speed cannot exceed 2500 RPM (Mobile PTO only).
- **TAP-DOWN:** Press and release the Set - switch position on the Cruise Switch to reduce the engine speed by increments of 100 RPM. The TAP-DOWN Engine Speed increments can be adjusted by GM Service Tool. The Service Tool can enable the option for adjustment of TAP-DOWN Engine Speed increments via Radio Customization menu.
- **COAST:** Press and hold the Set - switch position on the Cruise Switch to reduce the RPM at 148 RPM per second until the desired engine speed is reached or until the initial PTO standby speed is reached.

In-cab Cruise Res + Switch (or Remote PTO Tap Up switch)

- **RESUME**: After a PTO set speed has been achieved during PTO operation, a “RESUME SPEED” is retained after an application of the brake pedal. Engine speed will reduce to basic idle speed. The PTO Telltale will blink slowly indicating the previous PTO set speed has been retained in memory. Press and release the Res + switch position on the Cruise Switch to resume the previous PTO set speed.
- **TAP-UP:** Press and release the Res + position on the Cruise Switch to increase the engine speed by increments of 100 RPM (factory present value). The TAP-UP

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Engine Speed increments can be adjusted by the GM Service Tool. The Service Tool can enable the option for adjustment of TAP-UP Engine Speed increments via Radio Customization menu.

- **ACCEL**: Press and hold the Res + position on the Cruise Switch to increase the RPM by 148 RPM per second until the desired engine speed is reached or until the maximum allowable PTO set speed is reached. Alternatively, the engine speed acceleration can be adjusted via the Radio Customization menu.

11. Factory Preset Parameters

The following table lists the factory preset parameters. These may be altered by a GM Service tool to configure the various PTO features.

Item#	Parameter Name/ Function	Factory Setting	Minimum Value	Maximum or Alternate Value[s]
1	Operation Mode	PTO Stationary Preset Vehicle Stationary	Disabled	**STATIONARY** - Preset - Variable **MOBILE** - Variable [only]
2	PTO In-Cab Control	Enabled	Disabled	Enabled
3	PTO Remote Control Status	Enabled	Disabled	Enabled
4	PTO Personalization Standby Speed Menu (HMI Customization Display)	Enabled	Disabled	Enabled
6	PTO Personalization SET 1 Speed Menu (HMI Customization Display)	Enabled	Disabled	Enabled
7	PTO Personalization SET 2 Speed Menu (HMI Customization Display)	Enabled	Disabled	Enabled
8	PTO Personalization Engine Shutdown Time Menu (HMI Customization Display)	Enabled	Disabled	Enabled
9	PTO Personalization Tap Menu (Engine Speed) (HMI Customization Display)	Enabled	Disabled	Enabled
10	PTO OSIM (Operator Selectable In-Cab Mode) Control Status	Disabled (In-Cab PTO Mode)	Enabled (In-Cab PTO Mode)	1) PTO Remote Mode 2) OSIM
11	PTO Ramp Rate (Engine Speed Ramp)	148 RPM/s	4 RPM/s	148 RPM/s

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12	PTO Set 1 Speed	1200 RPM	1100 RPM	2500 RPM
13	PTO Set 2 Speed	1900 RPM	1700 RPM	2500 RPM
14	Interlock or Redundant Emergency Stop Feedback	NO	NO	YES
15	PTO Enable Solenoid On in Standby Disabled	YES	NO	YES
16 *	Fuel Level for Engine Shutdown	15%	0%	25% *
17	PTO On to Set 1 Speed Enable	Disabled	Disabled	Enabled
18	PTO Remote Variable Speed Enable	Disabled	Disabled	Enabled
19	PTO Remote Engine Start Enable	Disabled	Disabled	Enabled
20	PTO Remote Set Switch Enable	Disabled	Disabled	Enabled
21	PTO Remote Set Switch Type	Momentary	Momentary	Latching
22	PTO Remote Engine Shutdown	Disabled	Disabled	Enabled
23	Remote Set Switch Low = (<33% V_IGN) Low Input Signal Definition of Remote Mode Switch [Low Voltage State]	Set 1	Standby Speed/ set 1/set 2	Standby Speed/ set 1/set 2
24	Remote Set Switch High = (>66% V_IGN) High Input Signal Definition of Remote Mode Switch [High Voltage State]	Set 2	Standby Speed/ set 1/set 2	Standby Speed/ set 1/set 2
25	Remote Set Switch Open = (33% - 66% V_IGN) Default Input Signal Definition of Remote Mode Switch [Open State]	Standby Speed	Standby Speed/ set 1/set 2	Standby Speed/ set 1/set 2
26	PTO Min Engage Speed	500 RPM	500 RPM	1000 RPM
27	PTO Max Engage Speed	1500 RPM	1000 RPM	1800 RPM
28	PTO Max Engine Speed	2100 RPM	1100 RPM	2500 RPM
29	PTO Standby Speed	900 RPM	700 RPM	2100 RPM
30	Engine Run Timer, while PTO is Active	420 min	10 min	3480 min
31	PTO Remote Horn Chirp Before Start	Enabled	Disabled	Enabled
32	PTO Tap Step Engine Speed Change per Tap (Up/Down)	100 RPM	4 RPM	500 RPM
33	Brake Release Action-Engine Speed after Brake Event	Idle Speed (PTO Icon Flashing)	Idle Speed (PTO Icon Flashing)	Standby Speed [PTO ICON Solid] Max Vehicle Speed may be limited to 40 Km/h [25 mph] if this is programmed
34	PTO Remote Variable Speed Switch-PTO Remote Throttle [Potentiometer]	Disabled	Disabled	Enabled
35	PTO ON During Braking	Enabled	Disabled	Enabled

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	PTO Clutch ON in Standby [Keep PRO Engaged During Braking-Icon Flashing]			
36	Maximum Vehicle Speed-for PTO Operation	94 Km/h (58 mph)	30 Km/h (19 mph)	94 Km/h (58 mph)
37	PTO Throttle Override-Accelerator Pedal Disabled [Stationary mode only]	Enabled	Disabled	Enabled
38	PTO Throttle Override Time-Maximum Time Accelerator can be applied before PTO is Disabled	600 sec	60 sec	780 sec (13 min)
39	PTO Remote Minimum Variable Speed-PTO Remote Engine Speed Control Minimum Input Signal [Potentiometer Minimum]	2%	0%	50%
40	PTO Remote Maximum Variable Speed-PTO Remote Engine Speed Control Maximum Input Signal [Potentiometer Maximum]	95%	50%	100%
41	Engine Shutdown Enable	Enabled	Disabled	Enabled
42	Driver Door Status Usage	Enabled	Disabled	Enabled
43	Remote PTO InCab Control Enabled-Remote PTO InCAb Initiate	Disabled	Disabled	Enabled
Red * = parameter not programmable for Emergency vehicle provisions for PTO				

If the PTO factory preset parameters do not match the settings described above, then they may have already been altered to satisfy the requirements of the installed PTO system and body equipment.

The following PTO Settings are also offered via the vehicle customization screens, which can be enabled by your service technician. These include the following parameters:

- PTO Standby RPM
- PTO Set 1 Speed
- PTO Set 2 Speed
- Tap Step
- PTO Engine Run Timer

12. Driver Information Center (DIC) Warnings Messages

If the PTO telltale does not remain on (i.e. goes out after one second), this indicates that not all PTO enabling conditions have been satisfied. In the case, one or more of the following Driver Information Center (DIC) messages may appear on the instrument panel cluster if the PTO will not engage. The operator must take the action indicated, then again attempt to re-enable PTO.

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- PTO: SHIFT TO PARK (P) (Stationary only)
- PTO: SET PARK BRAKE (Stationary only)
- PTO: PRESS & RELEASE BRAKE (Mobile only)
- PTO: RELEASE BRAKE TO ENGAGE PTO
- PTO: REDUCE VEHICLE SPEED
- PTO: REDUCE ENGINE SPEED
- PTO: DISENGAGE CRUISE CONTROL

In addition to these messages, the PTO telltale will indicate when all conditions required to engage PTO have not been met. When enabling PTO, the PTO telltale will turn on, then turn off after one second. Under normal operating conditions, the PTO telltale will remain on throughout the PTO operating cycle.

Additional in-vehicle PTO module information can be accessed by the service technician to aid in troubleshooting. Also see service manual for more information.

The GM service technician can access service tool information which will contain reasons why PTO may not engage and reasons why PTO may unexpectedly disengage due to a system condition.

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13. Appendix: Safety Recommendations

No.	Safety Recommendations
1	PTO Feature has several characteristics that can be changed by configuration. Check all configuration selections carefully to avoid inadvertently deactivating safety mechanisms or impacting performance.
2	Upfitter's choice of components may affect performance. Even when system safety is available the overall performance of the system may be adversely affected by use of an improperly selected component or not following the recommended mechanization. The PTO System's safety mechanisms are designed to interrupt PTO operation in the event of a detected fault in related components or wiring.
3	The PTO safety mechanisms designed and built into the vehicle have been created by GM to cover PTO System operation only, which can include automatic engine shutdown to prevent unintended vehicle movement and protect the engine, transmission and PTO from damage. The PTO System should not be used for life support operations or an emergency back-up power source. Safety and function of any and all equipment added by the Upfitter to the vehicle is the responsibility of the Upfitter. Upfitter is responsible for compliance to applicable occupational health and safety standards, industrial safety standards or regulatory requirements.
4	Stationary Remote mode is not intended to operate with the vehicle's hood open. PTO system operation is terminated if the hood is opened during stationary operation.
5	Stationary Remote Mode is not intended to be operated with the ignition key in place.
6	Reference Best Practices Manual available through the GM Upfitter website. Reference incomplete vehicle document (IVD) for any additional regulatory requirements.

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Safety Reference Application

Component		Related Signal(s)		Applicable PTO System Configuration	Requirements for Achieving and Maintaining				
Description	Attribute	Pin	Signal		Specific Operator Action	Significance Effect on (to Vehicle Safety)	Vehicle Safety	Vehicle Performance	Effect on Significance (to Vehicle Performance)
Remote Arm Switch	N.O. Momentary Contact	A	PTO Remote Engine Arm	*Stationary, Remote* Mode Only	Wakes up PTO System to await further action	1.) First of two steps required to start the engine from a remote location outside the vehicle	*When starting these switches operate in tandem constituting a two-step operation that must be initiated in sequence before an engine start will take place. Activation (press and release) of either switch independently, or outside of the prescribed time window, is insufficient to initiate a start.* *When stopping the Remote Engine Shutdown/Start Switch operates independently supporting a fast shutdown if it becomes necessary for the operator to do so.*	*Both switches must be selected carefully to ensure proper performance and sufficient durability in the intended Upfitter application.*	Poor quality switches may not always activate switch contacts properly when pushed, resulting in a 'no start' when starting, or a 'no stop' when requesting a shutdown.
PTO Remote Engine Shutdown/Start Switch	N.C. Momentary Contact	J	PTO Remote Engine Shutdown / Start		If engine is running toggling this switch will disengage the PTO then shut down the engine	Initiates immediate disengagement of PTO and shutdown of vehicle's engine			
					If engine is not running PTO System initiates Engine Start followed by PTO Engage, but only if this switch is pressed and released within 5 seconds of activation of the Remote Arm Switch	2.) Second of two steps required to start the engine from a remote location outside the vehicle			

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Pendant Enable Switch	NC. Latching Contacts DPST Switch	J & K	Remote Pendant Connect/Disconnect		Switch must be OFF when Pendant is removed. Only close after Pendant is reconnected	Erratic signals to the control module are avoided during the reconnection of the Pendant	*Switching off the pendant will ensure that there is no faulty contact that will pull the remote start line high when the pendant is reattached.*	*This switch must be selected carefully to ensure proper performance and sufficient durability in the intended Upfitter application.*	Poor quality switches may activate inadvertently under vibration resulting in unwanted shutdowns or, if stuck in the 'out' position, prevent shutdown.
Emergency Stop Button	N.C. Contact 'A'	A	Engine Kill		Notifies PTO System that PTO disengagement and engine shutdown are required		*This device is required to support an emergency shutdown initiated from outside the vehicle and in the vicinity of the remote location, prominently visible and easily accessible, should it become necessary. Other shutdown mechanisms (e.g. in-cab ones) may be located a significant distance from the remote panel, impacting the operator's ability to initiate an emergency shutdown, if needed, quickly if this button is not added to the Upfitter's equipment design.*	*It is recommended that an Industry Standard Emergency Stop button be used, large in size and red in color, with two fixed positions. When pushed to the fixed 'in' or 'stop' position an Emergency Stop has been commanded; when returned to the fixed 'out' position normal operation will return, enabling a subsequent start request to be accepted.* *This switch must be selected carefully to ensure proper performance and sufficient durability in the intended Upfitter application.*	Poor quality switches may activate inadvertently under vibration resulting in an inadvertent shutdown; or could stick in the 'out' position preventing shutdown.
	N.C. Contact 'B'	R	(Run / Crank) IGN_1		PTO System opens PTO Relay to disengage PTO (redundant disengagement)	Initiates immediate disengagement of PTO and shutdown of vehicle's engine			
Localized Power for Upfitter to use in powering	Power Supply (Switched Battery via Ignition Key)				Fuse will open to protect internal and external circuitry in the	Current Limited, Protected by 10A Fuse	*A blown fuse must be always be replaced by one of the same capacity. Larger capacity*	*Smaller capacity fuses substituted in place of larger capacity fuses will blow too frequently.*	Fuses blowing too often results in operator /

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	Power Supply (switched Battery via Pendant Enable switch)	K V_BATT		event of excessive current draw	Current Limited, Protected by 10A Fuse	*fuses must never be substituted for smaller capacity fuses or circuit overloading will occur potentially resulting in ~~o~~verheating, damage to components or possibly fire.*		customer annoyance.
Remote Set Switch	N.O. Momentary Center-Off Pushbutton (Alternative 1)	N PTO Remote Mode PPS/Set		Sets/Controls Engine Speed via Up/Down Stepping (multiple speeds)	PTO System accepts and implements the speed change request	*This device, switch or potentiometer depending on the alternative chosen, sets / controls engine speed but the PTO System limits the maximum rate of change of engine speed during the transition to the newly selected speed.*	*This device must be selected carefully to ensure proper performance and sufficient durability in the intended Upfitter application.*	Failure of this device may result in the inability to set or change speed, or in speed changing inadvertently resulting in operator / customer annoyance.
	SPDT Two-Position (Alternative 2)			Selects/Controls Engine Speed via Two-Position Speed Select (High/Low)				
Remote Variable Speed Control	Potentiometer (Alternative 3)			Sets/Controls Engine Speed via Rotation between 0 and 100%				
PTO Engage Relay	Coil Terminal 1	D PTO Engage Relay High	All Modes and Configurations	Balanced drive used to eliminate the possibility that a short circuit in	Relay failure will be detected by the PTO System	*Must not be tied to ground or power or a diagnostics fault code will be set, and PTO functionality*	*The relay must be selected carefully to ensure proper performance and sufficient durability*	If this device fails too often this may result in operator

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			wiring could unintentionally activate the relay		*will be locked out until the fault is cleared[1].*	*in the intended Upfitter application. Poor quality relays fail more often.*	annoyance from safety responses occurring, and interrupting operation, too frequently.
Coil Terminal 2	H	PTO Engage Relay Low					
N.O. Contact	G	PTO Load Feedback	Provides confirmation that the PTO Relay has closed when requested, and that it opens when commanded to do so		*PTO load feedback provides confirmation that the load is in the state commanded, whether engaged or disengaged[1].* *Configuring load feedback monitoring 'off' via configuration will inhibit automatic PTO disengage (all modes)/engine shutdown (remote mode) if the load relay fails.*		

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General Ground	Power Return	D Vehicle Ground		Signal Reference	Reference for all signals monitored for faults that would lead to a safety issue	*Measurements made at various points within the system are taken with respect to a nearby ground in the harness or to the frame of the upfitted equipment. If this "local" ground is not at the same voltage level as the rest of the vehicle ground (which can happen if there is high resistance in the ground circuit) these measurements will not be consistent. Safety Mechanisms require that they must be.*	*Good grounding practices must be employed. Voltage drop between any two points in the ground system must not exceed 1.0 VDC.*	Safety mechanisms may activate unexpectedly , potentially leading to operator / customer annoyance.
Pendant Switch	Power Supply	J, Pendant Supply						

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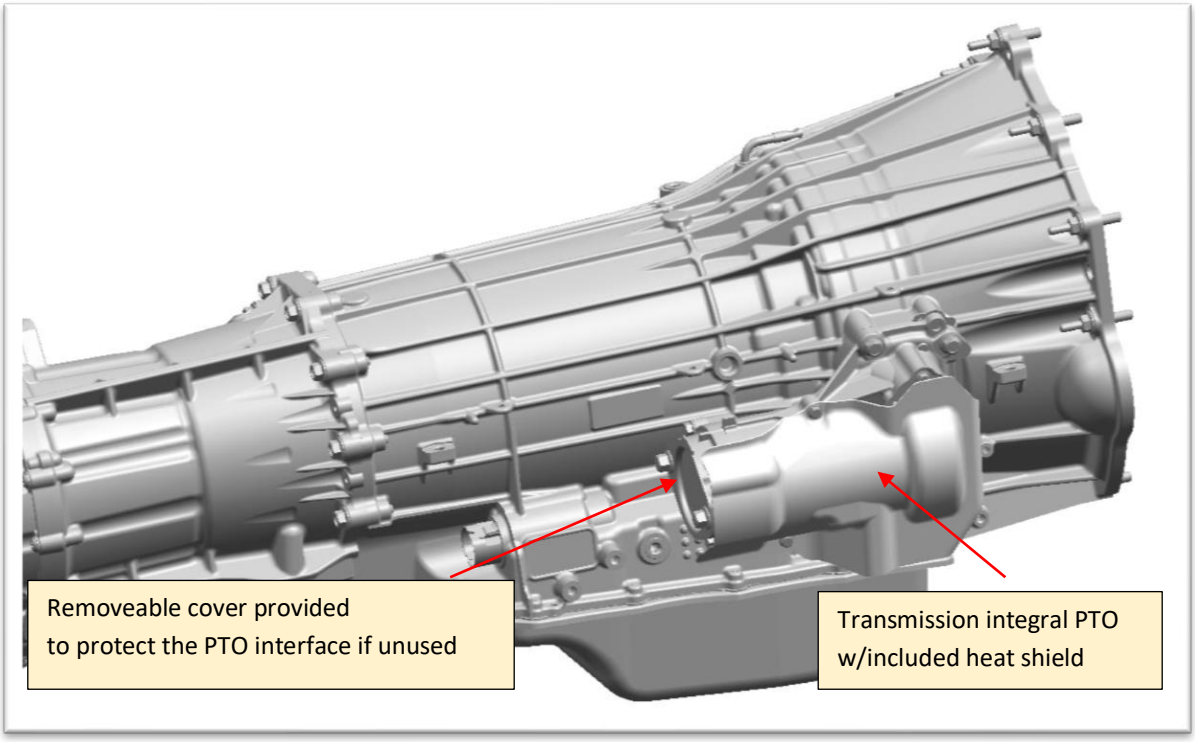
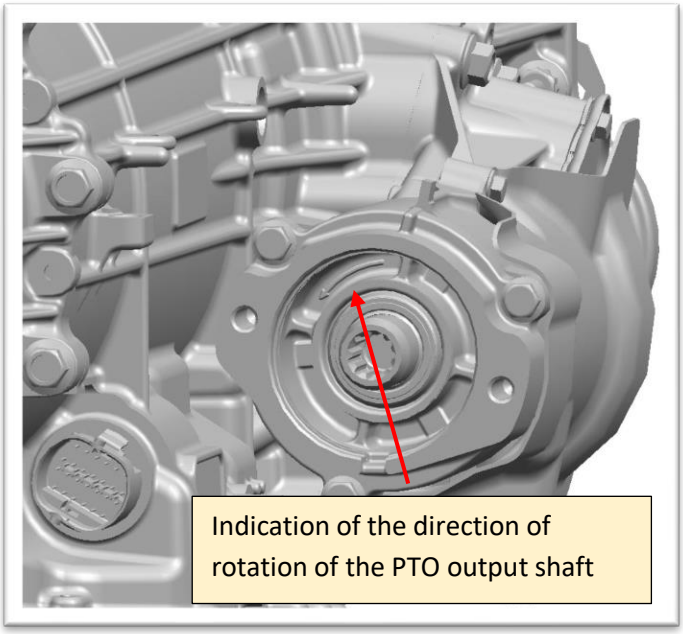
14. PTO Mechanical Information





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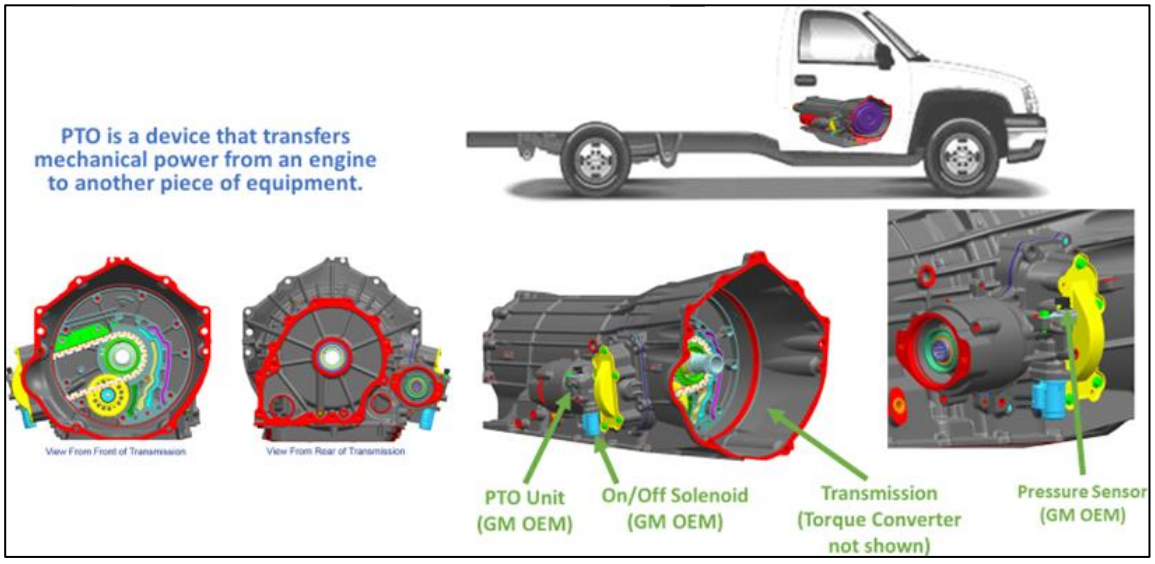
UI Bulletin #160c

MGU Transmission W/Integral PTO – Informational Summary

Parameter	Unit	Value	Notes
PTO Factory RPO's		Transmission w/integral PTO: MGU PTO Control Module:M1F Cruise Control: K34 Engine Controls: PTO	
PTO transmission interface		GM proprietary	
PTO Driven Device Interface		SAE J744 FEB2013 Revision Mounting: SAE "A" [82-1 (2 bolt)] 82.625 pilot diameter, 8mm deep M10 x 1.5 female boss, 24mm min full thread 106.4mm bolt circle Drive Shaft: SAE "A" ¾"-11T Female Spline	
PTO output shaft direction of rotation		Counter clockwise (when viewed on a transmission installed in a vehicle looking from the rear of the vehicle towards the front)	
Maximum PTO input/output speed	rpm	2500	Engine driven. 1:1 ratio to engine speed
Maximum PTO output torque	N*m (ft*lbs)	224 (165)	
Maximum PTO output power	kW (hp)	30 (40)	
Maximum PTO driven device inertia	$kg*m^2$	0.06	
Maximum unsupported mass able to be mounted to PTO interface	kg (lb)	13.5 (29.7)	
Maximum distance of Cg from mounting face	mm (in)	90 (3.5)	
PTO clutch apply solenoid		GM factory integrated with PTO control module	
PTO pressure sensor		GM factory integrated with PTO control module	


PTO is a device that transfers mechanical power from an engine to another piece of equipment.
View From Front of Transmission
View From Rear of Transmission
PTO Unit (GM OEM)
On/Off Solenoid (GM OEM)
Transmission (Torque Converter not shown)
Pressure Sensor (GM OEM)

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